

AMENDMENTS TO THE CLAIMS:

The following listing of claims replaces all prior listings, and all prior versions, of claims in the application.

Listing of Claims:

1-24. (Cancelled).

25. (Currently Amended) The polishing medium for chemical-mechanical polishing according to claim 62 24, wherein:

said abrasive grains have an average particle diameter of 50 nm or less, and said abrasive grains have standard deviation of particle size distribution in a value of more than 5 nm.

26. (Currently Amended) The polishing medium for chemical-mechanical polishing according to claim 62 24, wherein said abrasive grains are mixed in an amount of from 0.1% by weight to 5% by weight.

27. (Currently Amended) The polishing medium for chemical-mechanical polishing according to claim 62 24, which further comprises a water-soluble polymer, wherein the concentration of the oxidizing agent in the polishing medium is in a range of from 0.01% by weight to 1.8% by weight.

28. (Previously Presented) The polishing medium for chemical-mechanical polishing according to claim 27, wherein said water-soluble polymer is at least one selected from the group consisting of polyacrylic acid, a polyacrylic acid salt,

polymethacrylic acid, a polymethacrylic acid salt, polyamic acid, a polyamic acid salt, polyacrylamide, polyvinyl alcohol and polyvinylpyrrolidone.

29. (Previously Presented) The polishing medium for chemical-mechanical polishing according to claim 27, wherein said oxidizing agent is in a concentration of from 0.01% by weight to 1.5% by weight.

30. (Currently Amended) The polishing medium for chemical-mechanical polishing according to claim 62 24, wherein said acid is an organic acid.

31. (Previously Presented) The polishing medium for chemical-mechanical polishing according to claim 30, wherein said acid is at least one selected from malonic acid, malic acid, tartaric acid, glycolic acid and citric acid.

32. (Currently Amended) The polishing medium for chemical-mechanical polishing according to claim 62 24, wherein said protective-film-forming agent is at least one selected from benzotriazole and a derivative thereof.

33. (Currently Amended) The polishing medium for chemical-mechanical polishing according to claim 62 24, wherein said oxidizing agent is at least one selected from the group consisting of hydrogen peroxide, nitric acid, potassium periodate, hypochlorous acid and ozone water.

34. (Cancelled).

35. (Currently Amended) The polishing medium for chemical-mechanical polishing according to claim 62 ~~24~~, wherein said barrier layer ~~conductor~~ is a barrier layer for preventing copper atoms from diffusing.

36-37. (Cancelled).

38. (Currently Amended) As polishing condition, polishing pressure is 25 kPa and relative speed of substrate member to polishing platen is 18 m/minute, the polishing medium for chemical-mechanical polishing according to claim 59 ~~23~~, which has:

a polishing-rate ratio (Ta/Cu) between tantalum and copper or a copper alloy of more than 1;

a polishing-rate ratio (TaN/Cu) between tantalum nitride and copper or a copper alloy of more than 1;

a polishing-rate ratio (Ta/SiO₂) between tantalum and silicon dioxide of more than 10; and

a polishing-rate ratio (TaN/SiO₂) between tantalum nitride and silicon dioxide film of more than 10.

39. (Cancelled).

40. (Previously Presented) A method of polishing a substrate member comprising a step of polishing a surface including a wiring layer and a barrier layer, by the use of the polishing medium for chemical-mechanical polishing according to claim 38.

41. (Currently Amended) The polishing medium for chemical-mechanical polishing according to claim 62 24, wherein said abrasive grains are made of colloidal silica or colloidal alumina.

42. (Currently Amended) The polishing medium for chemical-mechanical polishing according to claim 59 23, which further comprises a water-soluble polymer.

43. (Previously Presented) The polishing medium for chemical-mechanical polishing according to claim 42, wherein said water-soluble polymer is at least one selected from the group consisting of polyacrylic acid, a polyacrylic acid salt, polymethacrylic acid, a polymethacrylic acid salt, polyamic acid, a polyamic acid salt, polyacrylamide, polyvinyl alcohol and polyvinylpyrrolidone.

44. (Previously Presented) The polishing medium for chemical-mechanical polishing according to claim 42, wherein said oxidizing agent is in a concentration of from 0.01% by weight to 1.5% by weight.

45. (Currently Amended) The polishing medium for chemical-mechanical polishing according to claim 59 23, wherein said acid is an organic acid.

46. (Previously Presented) The polishing medium for chemical-mechanical polishing according to claim 45, wherein said acid is at least one selected from malonic acid, malic acid, tartaric acid, glycolic acid and citric acid.

47. (Currently Amended) The polishing medium for chemical-mechanical polishing according to claim 59 23, wherein said protective-film-forming agent is at least one selected from benzotriazole and a derivative thereof.

48. (Currently Amended) The polishing medium for chemical-mechanical polishing according to claim 59 23, wherein said oxidizing agent is selected from the group consisting of hydrogen peroxide, nitric acid, potassium periodate, hypochlorous acid and ozone water.

49. (Currently Amended) The polishing medium for chemical-mechanical polishing according to claim 59 23, wherein said medium has a pH of 2.49 to 2.95.

50. (Currently Amended) The polishing medium for chemical-mechanical polishing according to claim 62 24, wherein said medium has a pH of 2.49 to 2.95.

51. (Currently Amended) As polishing condition, polishing pressure is 25 kPa and relative speed of substrate member to polishing platen is 18 m/minute, the polishing medium for chemical-mechanical polishing according to claim 62 24, which has:

a polishing-rate ratio (Ta/Cu) between tantalum and copper or a copper alloy of more than 1;

a polishing-rate ratio (TaN/Cu) between tantalum nitride and copper or a copper alloy of more than 1;

a polishing-rate ratio (Ta/SiO_2) between tantalum and silicon dioxide of more than 10; and

a polishing-rate ratio (TaN/SiO_2) between tantalum nitride and silicon dioxide film of more than 10.

52. (Previously Presented) A method of polishing a substrate member comprising a step of polishing a barrier layer containing tantalum, a tantalum alloy or a tantalum compound, by the use of the polishing medium for chemical-mechanical polishing according to claim 51.

53. (Previously Presented) A method of polishing a substrate member comprising a step of polishing a surface including a wiring layer and a barrier layer, by the use of the polishing medium for chemical-mechanical polishing according to claim 51.

54. (Currently Amended) The polishing medium for chemical-mechanical polishing according to claim 59 23, wherein said oxidizing agent has a concentration pH of 0.15 to 3% by weight[[3]].

55. (Currently Amended) The polishing medium for chemical-mechanical polishing according to claim 59 23, wherein said oxidizing agent has a concentration pH of 0.15 to 1.5% by weight [[1.5]].

56. (Currently Amended) The polishing medium for chemical-mechanical polishing according to claim 62 24, wherein said oxidizing agent has a concentration pH of 0.15 to 3% by weight [[3]].

57. (Currently Amended) The polishing medium for chemical-mechanical polishing according to claim 62 24, wherein said oxidizing agent has a concentration pH of 0.15 to 1.5% by weight [[1.5]].

58. (Cancelled)

59. (New) A polishing medium for chemical-mechanical polishing, adapted to polish a barrier layer of tantalum, a tantalum alloy or a tantalum compound, for a conductor of copper, copper alloy, or copper oxide, comprising:

- an oxidizing agent;

- a protective-film-forming agent;

- an acid; and

- water, wherein:

 - said polishing medium does not include abrasive grains,

 - said polishing medium has a pH of 3 or less, and

 - said oxidizing agent is in a concentration of from 0.01% by weight to 3% by weight.

60. (New) The polishing medium for chemical-mechanical polishing according to claim 59, wherein the polishing medium has a property that a ratio of a polishing rate of the barrier layer using the polishing medium, to a polishing rate of the conductor using the polishing medium, is greater than 1.

61. (New) The polishing medium for chemical-mechanical polishing according to claim 59, wherein said polishing medium includes said oxidizing agent in a concentration of from 0.01% by weight to 1.8% by weight.

62. (New) A polishing medium for chemical-mechanical polishing, adapted to polish a barrier layer of tantalum, a tantalum alloy or a tantalum compound, for a conductor of copper, copper alloy, or copper oxide, comprising:

an oxidizing agent;

a protective-film-forming agent;

abrasive grains;

an acid; and

water, wherein:

said polishing medium has a pH of 3 or less, and

said oxidizing agent is in a concentration of from 0.01% by weight to 3% by weight.

63. (New) The polishing medium for chemical-mechanical polishing according to claim 62, wherein the polishing medium has a property that a ratio of a polishing rate of the barrier layer using the polishing medium, to a polishing rate of the conductor

using the polishing medium, is greater than 1.

64. (New) The polishing medium for chemical-mechanical polishing according to claim 62, wherein said polishing medium includes said oxidizing agent in a concentration of from 0.01% by weight to 1.8% by weight.

65. (New) A polishing medium for chemical-mechanical polishing of a surface having at least one of tantalum, tantalum alloy and a tantalum compound, comprising:
an oxidizing agent;
a protective-film-forming agent;
an acid; and
water; wherein:
said polishing medium does not include abrasive grains,
said polishing medium has a pH of 3 or less, and
said oxidizing agent is in a concentration of from 0.01% by weight to 3.0% by weight.

66. (New) The polishing medium for chemical-mechanical polishing according to claim 65, wherein said medium has a pH of 2.49 to 2.95.

67. (New) The polishing medium for chemical-mechanical polishing according to claim 65, wherein said oxidizing agent has a concentration of 0.15 to 3.0% by weight.

68. (New) The polishing medium for chemical-mechanical polishing according

to claim 65, wherein said oxidizing agent has a concentration of 0.15 to 1.5% by weight.

69. (New) A polishing medium for chemical-mechanical polishing of a surface having at least one of tantalum, tantalum alloy and a tantalum compound, comprising:
an oxidizing agent for a conductor;
a protective-film-forming agent for protecting a metal surface;
an acid;
water; and
abrasive grains, wherein:
said polishing medium has a pH of 3 or less; and
said oxidizing agent is in a concentration of from 0.01% by weight to 3.0% by weight.

70. (New) The polishing medium for chemical-mechanical polishing according to claim 69, wherein said medium has a pH of 2.49 to 2.95.

71. (New) The polishing medium for chemical-mechanical polishing according to claim 69, wherein said oxidizing agent has a concentration of 0.15 to 3.0% by weight.

72. (New) The polishing medium for chemical-mechanical polishing according to claim 69, wherein said oxidizing agent has a concentration of 0.15 to 1.5% by weight.

73. (New) A method of polishing a substrate member, comprising a step of polishing a barrier layer containing tantalum, a tantalum alloy or a tantalum compound

by the use of a polishing medium for chemical-mechanical polishing, said polishing medium including:

an oxidizing agent;

a protective-film-forming agent;

an acid; and

water, wherein:

said polishing medium does not include abrasive grains,

said polishing medium has a pH of 3 or less, and

said oxidizing agent is in a concentration of from 0.01% by weight to 3% by weight, and wherein:

the polishing medium for chemical-mechanical polishing has, under polishing conditions of a polishing pressure of 25 kPa and relative speed of substrate member to polishing platen of 18m/minute:

a polishing-rate ratio (Ta/Cu) between tantalum and copper or a copper alloy of more than 1;

a polishing-rate ratio (TaN/Cu) between tantalum nitride and copper or a copper alloy of more than 1;

a polishing-rate ratio (Ta/SiO₂) between tantalum and silicon dioxide of more than 10; and

a polishing-rate ratio (TaN/SiO₂) between tantalum nitride and silicon dioxide of more than 10.

74. (New) The method according to claim 73, wherein said medium has a pH of 2.49 to 2.95.

75. (New) The method according to claim 73, wherein said oxidizing agent has a concentration of 0.15 to 1.5% by weight.

76. (New) The method according to claim 73, wherein said oxidizing agent has a concentration of 0.15 to 1.5% by weight.

77. (New) A method of polishing a substrate member having a barrier layer containing at least one of tantalum, a tantalum alloy and a tantalum compound overlying an insulator and a conductor layer containing at least one of copper, a copper alloy and copper oxide on the barrier layer, comprising:

chemical-mechanical polishing the conductor layer, using a first chemical-mechanical polishing medium, so as to remove portions of the conductor layer and expose portions of the barrier layer, in a first step; and

thereafter, chemical-mechanical polishing exposed portions of the barrier layer, using a second chemical-mechanical polishing medium, wherein the second chemical-mechanical polishing medium comprises:

an oxidizing agent;

a protective-film-forming agent;

an acid; and

water, wherein:

said polishing medium has a pH of 3 or less, and

said oxidizing agent is in a concentration of from 0.01% by weight to 3% by weight.

78. (New) The method according to claim 77, wherein said medium has a pH of 2.49 to 2.95.

79. (New) The method according to claim 77, wherein said oxidizing agent has a concentration of 0.15 to 1.5% by weight.

80. (New) The method according to claim 77, wherein said oxidizing agent has a concentration of 0.15 to 1.5% by weight.

81. (New) The method according to claim 77, wherein the second chemical-mechanical polishing medium does not include abrasive particles.

82. (New) The method according to claim 77, wherein the second chemical-mechanical polishing medium contains abrasive particles.

83. (New) The method according to claim 77, wherein said first polishing medium is different from said second polishing medium, and polishes the at least one of copper, copper alloy and copper oxide at a higher polishing rate than the polishing rate by the first polishing medium of said at least one of tantalum, tantalum alloy and tantalum compound.

84. (New) The method according to claim 77, wherein said insulator includes dales, and the barrier layer is provided in said dales and said conductor layer fills said

dales.

85. (New) A polishing medium for chemical-mechanical polishing, adapted to polish a barrier layer of tantalum, a tantalum alloy or a tantalum compound, for a conductor of copper, copper alloy or copper oxide, comprising:

at least one selected from the group consisting of hydrogen peroxide, nitric acid, potassium periodate, hypochlorous acid and ozone water;

at least one selected from benzotriazole and a derivative thereof;

an acid; and

water, wherein:

said polishing medium does not include abrasive grains,

said polishing medium has a pH of 3 or less, and

said oxidizing agent is in a concentration of from 0.01% by weight to 3% by weight.

86. (New) The polishing medium for chemical-mechanical polishing according to claim 85, wherein said medium has a pH of 2.49 to 2.95.

87. (New) The polishing medium for chemical-mechanical polishing according to claim 85, wherein said oxidizing agent has a concentration of 0.15 to 3.0% by weight.

88. (New) The polishing medium for chemical-mechanical polishing according to claim 85, wherein said oxidizing agent has a concentration of 0.15 to 1.5% by weight.

89. (New) A polishing medium for chemical-mechanical polishing, adapted to polish a barrier layer of tantalum, a tantalum alloy or a tantalum compound, for a conductor of copper, copper alloy or copper oxide, comprising:

at least one selected from the group consisting of hydrogen peroxide, nitric acid, potassium periodate, hypochlorous acid and ozone water;

at least one selected from benzotriazole and a derivative thereof;

abrasive grains;

an acid; and

water, wherein:

said polishing medium has a pH of 3 or less, and

said oxidizing agent is in a concentration of from 0.01% by weight to 3% by weight.

90. (New) The polishing medium for chemical-mechanical polishing according to claim 89, wherein said medium has a pH of 2.49 to 2.95.

91. (New) The polishing medium for chemical-mechanical polishing according to claim 89, wherein said oxidizing agent has a concentration of 0.15 to 3.0% by weight.

92. (New) The polishing medium for chemical-mechanical polishing according to claim 89, wherein said oxidizing agent has a concentration of 0.15 to 1.5% by weight.

93. (New) A polishing medium for chemical-mechanical polishing of a surface

having at least one of tantalum, tantalum alloy and a tantalum compound, comprising:

at least one selected from the group consisting of hydrogen peroxide, nitric acid, potassium periodate, hypochlorous acid and ozone water;

at least one selected from benzotriazole and a derivative thereof;

an acid; and

water, wherein:

said polishing medium does not include abrasive grains,

said polishing medium has a pH of 3 or less, and

said oxidizing agent is in a concentration of from 0.01% by weight to 3% by weight.

94. (New) The polishing medium for chemical-mechanical polishing according to claim 93, wherein said medium has a pH of 2.49 to 2.95.

95. (New) The polishing medium for chemical-mechanical polishing according to claim 93, wherein said oxidizing agent has a concentration of 0.15% by weight to 3% by weight.

96. (New) The polishing medium for chemical-mechanical polishing according to claim 93, wherein said oxidizing agent has a concentration of 0.15% by weight to 1.5% by weight.

97. (New) A polishing medium for chemical-mechanical polishing of a surface having at least one of tantalum, tantalum alloy and a tantalum compound, comprising:

at least one selected from the group consisting of hydrogen peroxide, nitric acid, potassium periodate, hypochlorous acid and ozone water;

at least one selected from benzotriazole and a derivative thereof;

an acid;

water; and

abrasive grains, wherein:

said polishing medium has a pH of 3 or less; and

said oxidizing agent is in a concentration of from 0.01% by weight to 3.0% by weight.

98. (New) The polishing medium for chemical-mechanical polishing according to claim 97, wherein said medium has a pH of 2.49 to 2.95.

99. (New) The polishing medium for chemical-mechanical polishing according to claim 97, wherein said oxidizing agent has a concentration of 0.15 to 3.0% by weight.

100. (New) The polishing medium for chemical-mechanical polishing according to claim 97, wherein said oxidizing agent has a concentration of 0.15 to 1.5% by weight.